Double Inverse Opals - A New Approach for a Switchable Complete Photonic Bandgap

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The intriguing optical properties of photonic crystals have stimulated many design and application concepts over the past nearly two decades. As technology advances there is now not only a desire for static systems with certain properties but also an increasing interest in tunable or switchable structures.

In this work we present a novel approach to achieve a switchable complete photonic bandgap. We show that a structure consisting of a high index inverse opal backbone with additional movable dielectric scatterers with a lower refractive index in the air voids has a complete photonic bandgap for certain positions of the scatterers while it is closed for other positions. This is mainly due to a shift of frequencies at the air band where the eigenmodes are most sensitive to changes of the refractive index in low-index regions. We perform a numerical analysis of the parameter dependencies of this effect and discuss prospects of an experimental realisation, including a proposal for the switching process itself by incorporating metallic particles into the movable scatterers and the application of external fields.